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Effects of Embodiment-Based Learning on Perceived Cooperation Process and Social Flow

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Abstract

Peer interaction plays an important role during the learning process. Currently predominant paradigm of digital learning materials limits learners' interaction with their peers using traditional user interfaces. To cope with this problem, this study proposes an embodiment-based learning environment to facilitate more peer interactions. The effectiveness of the environment is evaluated by designing an electronic circuit learning activity and through a control-experimental group experiment, including 80 voluntary participants randomly assigned to the "embodiment-based learning group" and "traditional learning group." Three variables, learning performance, perceived cooperative perception and social flow were assessed. Results show that there is no significant difference among the two groups in learning performance; however, participants in the embodiment-based learning group have higher perceived cooperation process and social flow during learning process than the traditional learning group.

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Keywords: Embodiment-based learning; Cooperative learning; Cooperation process; Social flow; Learning performance

1. Introduction

Information and communication technologies have emerged as indispensable learning tools for young students, offering education, recreational entertainment, information exchange, and interpersonal relations. Educators should appropriately adjust educational methods and incorporate digital learning technologies to evolve with these learners

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(Margaryan, Littlejohn, & Vojt, 2011; Prensky, 2001; Vodanovich, Sundaram, & Myers, 2010). Vodanovich, Sundaram, and Myers (2010) have noted that if we wish to ensure appropriate design and inclusive access to emerging technologies for the digital native learners, we must include the five dimensions of personalization, interactivity, intuitiveness, attractiveness, and social, which are also all interrelated. This study in consideration of the characteristics of digital native learners and development of new technologies, establishes a somatosensory embodiment-based learning environment to support learning. The embodiment-based learning environment provides learners with graphical user interface, touch interface, gesture recognition, body movement recognition and voice recognition to intuitively interact with somatosensory technologies. When learners fully immerse in learning activities, their learning motivation, learning participation and learning performance can be enhanced (Ang et al., 2013; Ozcelik & Sengul, 2012).

This study explores the effect of embodiment-based learning environment in courses on basic circuits and digital logic, which are core courses for students majoring in information science or engineering. When learners have a deep knowledge and understanding of the basis for the design and construction of digital logic circuits, it will help them in the future to learn advanced information technologies, electronics and motor-related courses. The aim is to analyze whether an embodiment-based learning environment has positive influences on perceived cooperative perception and social flow.

2. Literature review

Somatosensory technology is a kind of nature user interface which enables users to communicate with the computer system more intuitively through interactions such as body movements, gestures, multi-touch sensing and spoken commands (Wigdor & Wixon, 2011). The concept and application of nature user interfaces are often reflected in emerging technologies such as smart phones and motion sensing input devices. Majority of today’s smart phones have built-in multi-touch sensor, acceleration sensor, ambient light sensor, proximity sensor, three-axis gyroscope and fingerprint reader. Some of them are equipped with even more advanced sensors, such as eye tracking, head tracking and heart rate sensors. Motion sensing input devices are usually equipped with an RGB camera, depth sensor and multi-array microphone. Somatosensory technologies provide full-body 3D motion capture, facial recognition, eye tracking, physiological measurement, and voice recognition capabilities.

Many innovative applications for somatosensory technologies have been proposed in recent years, such as language learning, assisted living for the differently abled, medical rehabilitation, and posture adjustment in sports physiology (Hwang, Wu, & Kuo, 2013; Sheu & Chen, 2014; Zaharias, Michael, & Chrysanthou, 2013). In terms of language learning, somatosensory technologies have been used to propose game-based learning approaches to enable more immersive experience for the learners in simulation environments. In assisted living for the differently abled, somatosensory technologies have been used to design assistant applications for visually impaired and physically handicapped persons, so that they can become more self-reliant. In medical rehabilitation, somatosensory technologies have been deployed in physical therapy, allowing users to achieve rehabilitation results through game-based therapy applications. As for posture adjustment in sports physiology, some elementary schools have used somatosensory equipment to create physical fitness system. The system analyzes children’s running and long jump postures, and provides guidelines and tips to make adjustments. This not only encourages children with limited physical education skills to perform with courage, but also helps them to concentrate on learning movement fundamentals.

3. Research methods

The learning tasks in this study aim to provide students with the understanding of various terms used in electronic circuit elements, the basic concepts and physical phenomena involved, and the ability to select correct components and complete a circuit assembly. Pre-test and post-test were conducted to evaluate learning effectiveness. A questionnaire was designed to measure learners' perception of cooperation process (including cooperation extent, task conflict and emotional conflict) and social flow (including control, attention focus, curiosity, and intrinsic interest).

Perception of cooperation extent refers to subjective perception of members of the group regarding discussions, information exchange, and interaction. Perception of emotional conflict refers to interpersonal conflict among the group members, such as arguments, tension, and worry. Perception of task conflict refers to the differences in group members' ideas about or perspectives of cooperation for the task contents. Perception of cooperation extent and task conflict can help improve cooperative learning outcomes, while perception of emotional conflict will have a negative impact on cooperative learning. The scale of perceived cooperation extent was modified from Tjosvold's proposed scale (1988) and has seven items. Two scales of perceived task conflict with four items and emotional conflict with four items were derived from Jehn's scales (1995).

Social flow is based on Csikzentmihalyi's flow theory (Csikzentmihalyi, 1975). The construct seeks to measure the perception of immersion in a multiplayer interactive environment. Csikszentmihalyi & Csikszentmihalyi (1988) pointed out that people's flow experiences occur at the intersection of the two facets of challenges and skills which could match or exceed a certain level. When the challenge and skills are consistent, people will be in a state of immersion. In this research, a questionnaire has been adapted from Ryu & Parsons' scale with a total of 12 items (Ryu & Parsons, 2012) to measure four dimensions of social flow, namely control, attention focus, curiosity, and intrinsic interest, when learners are engaged in the cooperative process. Control refers to the degree to which team members exhibit mastery and control of the learning system. Attention focus is the concentration degree of team members on the learning tasks. Curiosity is the degree to which team members express curiosity for the learning tasks. Intrinsic interest refers to which team members develop internal interest for the learning tasks. All questionnaire items were designed on a 5-point Likert scale.

The subjects of this study were students majoring in information technology or engineering. A total of 80 volunteers were recruited for the experiment (20 females and 60 males) and were randomly assigned to the control group (traditional learning group) and experimental group (embodiment-based learning group). The groups were further divided into cooperation team, with two persons in each team. Learning materials included four electronic circuit assembly projects, supplemented by related electronic circuit elements. Learners were expected to recognize the component characteristics and the circuit structure of each project. Each cooperation team was expected to assemble these projects correctly.

4. Experiment design

Before learners entered the cooperative learning phase, they were asked to first complete the pre-tests in order to ascertain their prior knowledge regarding the learning tasks. After studying the relevant materials and completing the cooperative tasks, a post-test was conducted to record individual learner's understanding of the learning unit. This study's embodiment-based learning environment provides two projects including a two-speed fan and music radio, and each project is divided into two stages including a parts selection stage and parts assembly stage.

Figure 1. Part selection stage of the experimental group

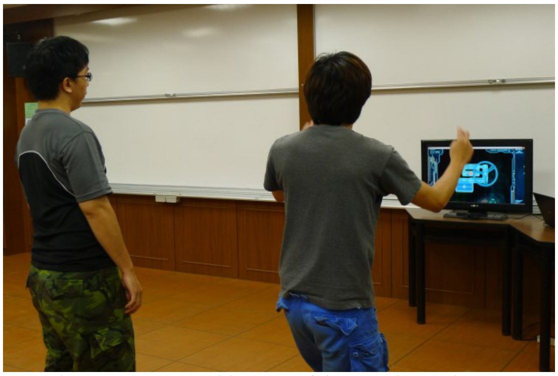

Figure 2. Part assembly stage of the experimental group

As shown in figure 1, the students were asked to select various parts in the system for each project, and the team members were expected to make correct body movement gesticulation to select all the parts for each project. The parts contained on them a name and description. The selected parts were placed in the parts storage area until use in the assembly stage. As shown in figure 2, in the assembly stage, the team members were asked to place all the parts in the proper locations in the electronic circuit and confirm the correct places. The system then determined whether the placement was correct or not. If the placement was correct then the next challenge was given to the students. Otherwise, the part was returned to the storage area, and the learners were asked to return to the parts storage area to replace the part.

Figure 3. Part selection stage of the control group

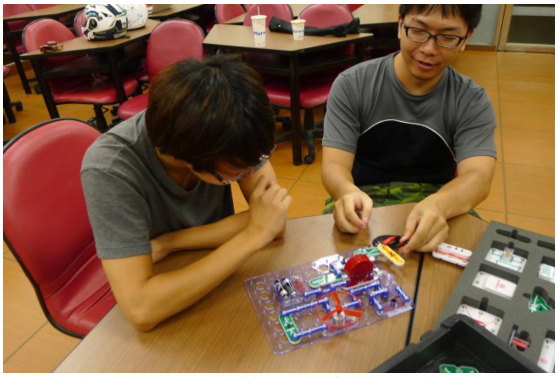

Figure 4. Part assembly stage of the control group

For the traditional learning groups, figure 3 shows team members selecting electronic circuit parts needed for their project. Figure 4 shows them finding the correct location for the parts assembly to complete the project requirements.

The timeline for the whole experimental process was as follows: subjects first completing the pre-test, then studying the learning materials, and completing the 40 minute cooperative task. During the cooperative task the control groups use actual electronic circuit assemblages, while the experimental groups use the somatosensory system. Finally, the post-test and questionnaire are completed.

5. Results

In this study, independent sample t-test is used to verify all of the hypotheses, and when the test results reach a p_value < 0.05, this indicates that the hypothesis was well-founded, otherwise the hypothesis is not established.

5.1. Learning performance

The mean of pre-test score in the control group (5.025) was slightly lower than the experimental group (5.325), but less than the significant level. The mean of post-test score in the control group (8.100) was slightly lower than the experimental group (8.350), but did not reach the significant level. Therefore, no significant difference was found between the two groups in terms of learning performance.

5.2. Cooperation process

The mean score of perceived cooperation extent for the control group (4.013) was significantly lower than for the experimental group (4.408), and reached a significant level (p_value=.006). Therefore the findings suggest that in the context of cooperative learning, embodiment-based learning environments significantly enhance the perception of cooperation extent. In other words, embodiment-based learning environments help to promote better cooperative behavior among the learning groups.

The mean score of perceived emotional conflict for the control group (2.142) was significantly higher than for the experimental group (1.658), and reached a significant level (p_value=.006). Therefore findings suggest that in the context of cooperative learning, embodiment-based learning environments significantly reduce the perception of emotional conflict. In other words, embodiment-based learning environments help reduce emotional conflict between the cooperative teams.

The mean score of perceived task conflict for the control group (2.631) was higher than for the experimental group (2.344), but less than the significant level. Therefore, in the context of cooperative learning, no significant difference was found between the two groups in terms of perceived task conflict.

5.3. Social flow

The mean score of perceived control for the control group (3.942) was significantly lower than the experimental group (4.250), and reached a significant level (p_value=.037). Therefore the findings suggest that in the context of cooperative learning, embodiment-based learning environments significantly improve the perception of control.

The perception of attention focus refers to the extent of team members focus during the cooperation process. The mean score of perceived attention focus for the control group (3.842) was significantly lower than the experimental group (4.150), and reached a significant level (p_value=.049). Therefore the findings suggest that in the context of cooperative learning, embodiment-based learning environments significantly enhance the perception of attention focus. These environments allow for the learning task group activities to be conducted through intuitive body movements, so learners can focus more on the learning task itself. This hypothesis is at the edge of significance and not significant, so follow-up study is needed to address this issue through in-depth inquiry.

The mean score of perceived curiosity for the control group (3.717) were significantly lower than the experimental group (4.050), and reached a significant level (p_value=.039). Therefore the findings suggest that in the context of cooperative learning, embodiment-based learning environments can significantly enhance the perception of curiosity.

The mean score of perceived intrinsic interest for the control group (3.950) were significantly lower than the experimental group (4.412), and reached a significant level (p_value=.002). Therefore the findings suggest that in the context of cooperative learning, embodiment-based learning environments significantly enhance the perception of intrinsic interest.

6. Conclusions

This study investigated embodiment-based learning environments for influences on learning performance, perceptions of cooperation process and social flow. The results of the experimental study revealed that, although the effectiveness of embodiment-based learning groups was not significantly better than the traditional learning groups, two dimensions of cooperation process and all dimensions of social flow reached significant levels. The somatosensory technologies are therefore quite worthy of being used in mainstream learning environments.

The purpose of learning is not only to attain cognitive and learning skills, but also to develop the emotional sense. The most valuable asset of keeping learners in school may be to form groups of like-minded peers as partners, which is the biggest difference from studying alone at home or on-line. Learning together with peers can cultivate the spirit of teamwork, training in the ability to resolve conflicts, sharing about learning experiences, and encouragement and support for each other (Wei, Chen, & Kinshuk, 2012).

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